

# TRANSFORMATIONS

Parabola

$$\frac{\text{General Equations}}{f(x) = \pm a(x-h)^2 + k}$$

Square Root

$$f(x) = \pm a\sqrt{x-h}$$

absolute  
value

$$f(x) = \pm a|x-h| + k$$

Semicircle

$$f(x) = \pm a\sqrt{1 - \left(\frac{x-h}{c}\right)^2} + k$$

# Vertical Shift

**K** will move your graph  $\uparrow$  or  $\downarrow$

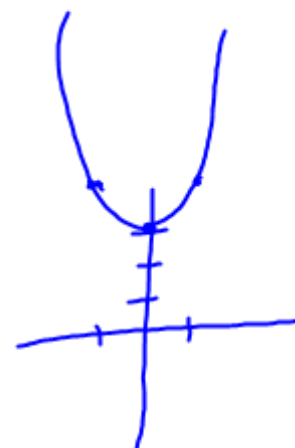
ex) parabola

$$y = x^2$$



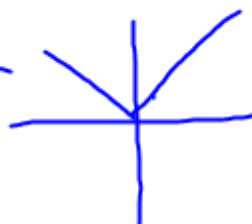
$$y = x^2 + 3$$

x	y
0	3
1	4
-1	4



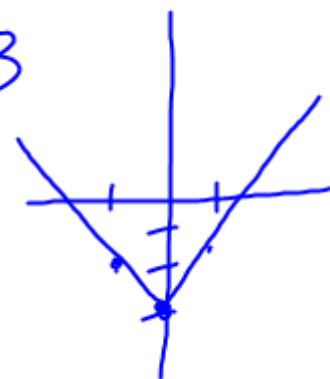
ex) absolute value

$$y = |x| + k$$



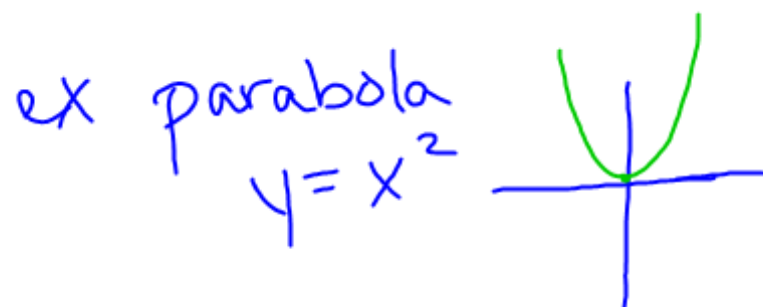
$$y = |x| - 3$$

x	y
0	-3
1	-2
-1	-2



# Horizontal Shift

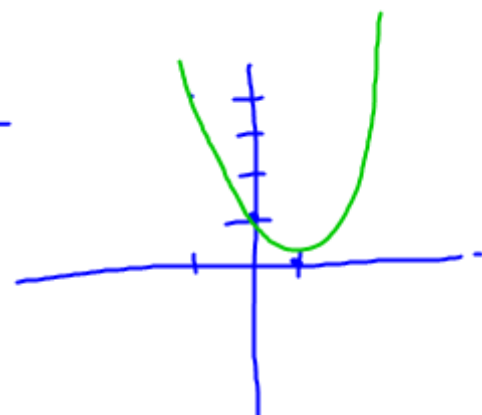
$h$  moves your graph left or right



$$y = (x - 1)^2$$

↓

x	y
0	1
-1	4
1	0

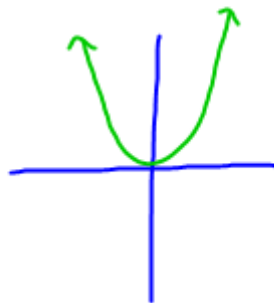


\* notice we put a  $+1$  in the general equation & it moves it  $\rightarrow$  but in this equation it reads as  $-1$

# Horizontal Cont.

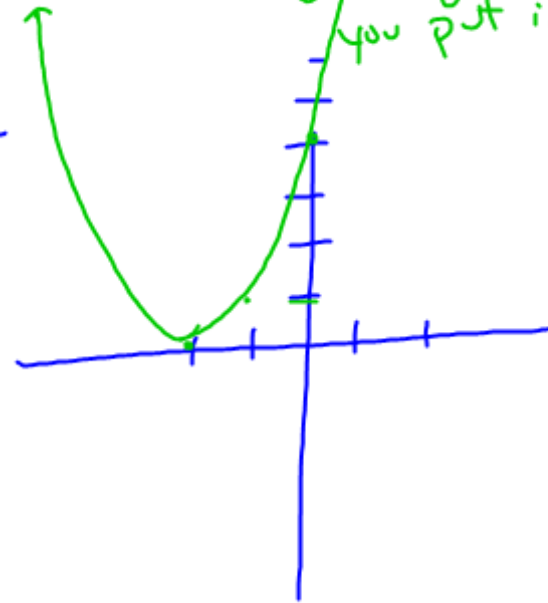
ex parabola

$$y = x^2$$



$$y = (x+2)^2$$

x	y
0	4
-1	1
-2	0
-3	1



general form

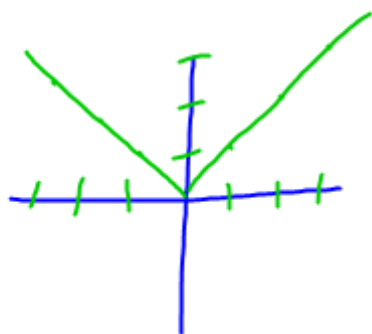
$$y = (x-h)^2$$

so to get  $(x+2)^2$   
you put in a -2

# Stretch & Reflect

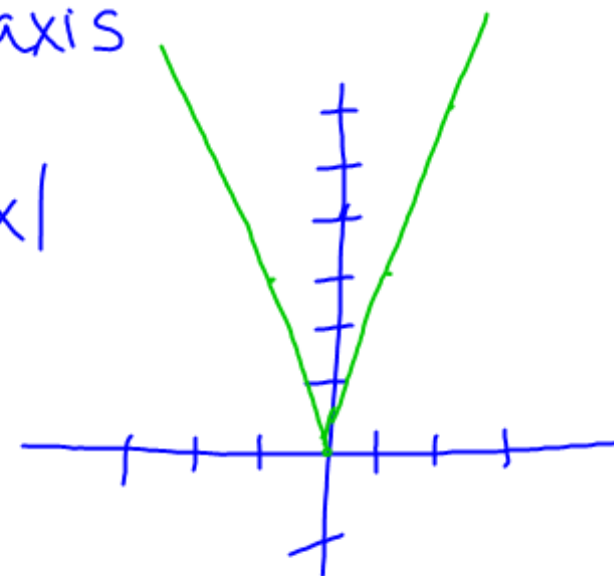
a will compress & stretch your graph  
and changing the sign will reflect  
the graph over the x-axis

ex  $y = |x|$



ex)  $y = 3|x|$

x	y
0	0
1	3
-1	3
2	6



\* becomes steeper

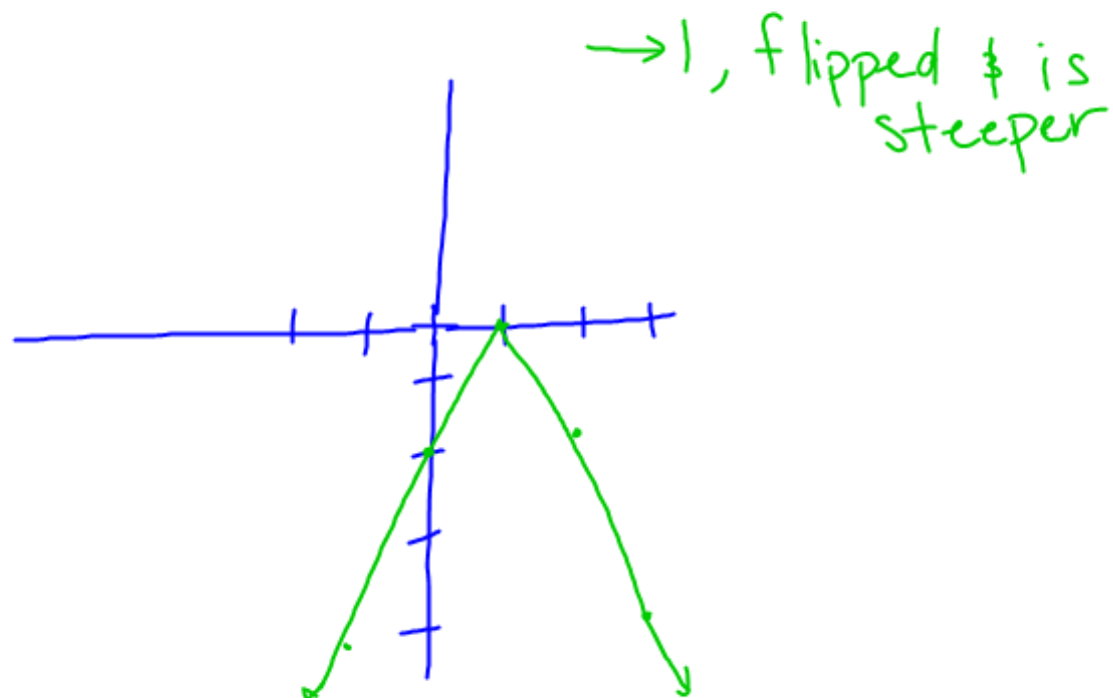
# Stretch & Reflect cont

ex

$$y = -2|x-1|$$

↑ ↑      ↑

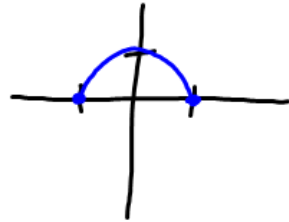
x	y
3	-4
2	-2
1	0
0	-2
-1	-4



# Semicircle Review

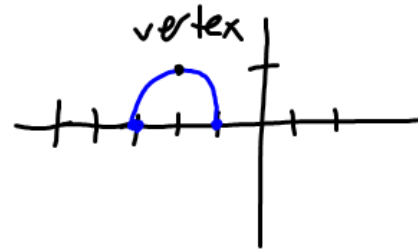
Normal

$$f(x) = \sqrt{1-x^2}$$



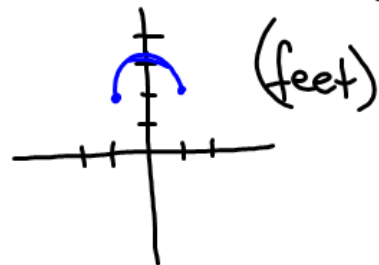
Horz. Shift

$$f(x) = \sqrt{1-(x+2)^2}$$



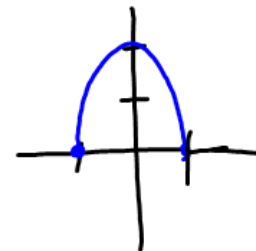
vertical shift

$$f(x) = \sqrt{1-x^2} + 2$$



vert. stretch

$$f(x) = 2\sqrt{1-x^2}$$

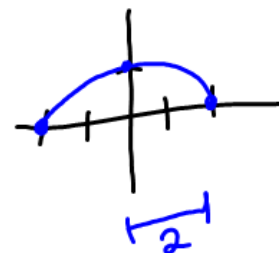


general form

$$f(x) = \pm a \sqrt{1 - \left(\frac{(x-h)^2}{c^2}\right)} + k$$

Horz. stretch

$$f(x) = \sqrt{1 - \left(\frac{x}{2}\right)^2}$$



# Practice Problems

- 1) Given a parabola with a vertex at  $(3, -5)$  and passing through points  $(4, -3)$  &  $(2, -3)$ , write the equation of a quadratic.

$$f(x) = 2(x-3)^2 - 5$$

- 2) Find the equation of each graph described

- A) a square root function that extends left starting at  $(3, 1)$  & passing through the point  $(2, 2)$

$$f(x) = \sqrt{-x+3} + 1 \quad \text{OR} \quad f(x) = \sqrt{-(x-3)} + 1$$

- B) A semi-circle with endpoints at  $(-1, -2)$  &  $(-5, -2)$  & a top at  $(-3, 3)$

$$f(x) = 5\sqrt{1 - \left(\frac{x+3}{2}\right)^2} - 2$$

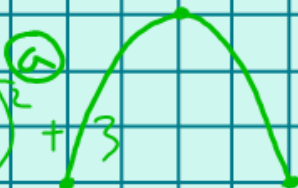
- C) an absolute value function opening downwards with a vertex  $(2, 1)$  and passing through  $(0, 0)$  &  $(4, 0)$

$$f(x) = -\frac{1}{2}|x-2| + 1$$



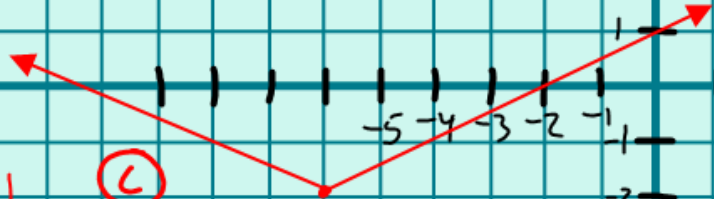
③ Find the equation for each graph

⑥  $f(x) = 3\sqrt{1 - \left(\frac{x+5}{2}\right)^2} + 3$

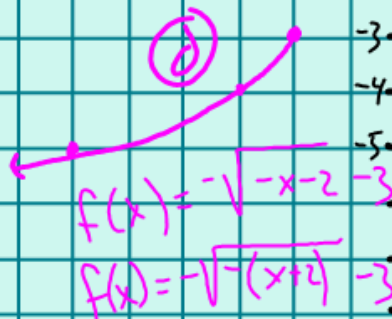


X

⑦  $f(x) = \frac{1}{2}|x+6| - 2$

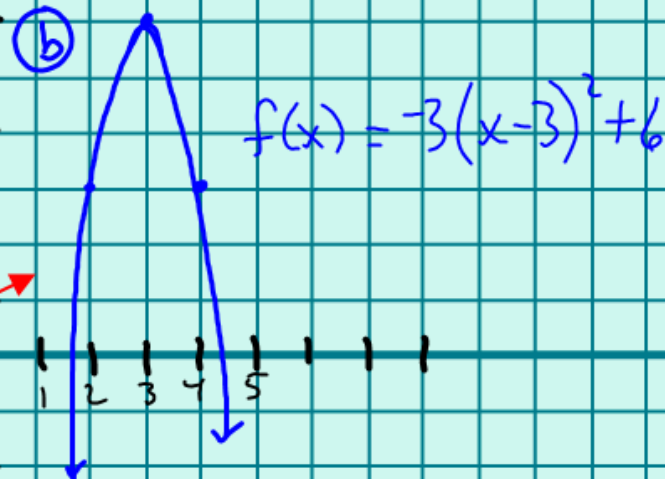


⑧  $f(x) = -\sqrt{-x-2} - 3$   
 $f(x) = -\sqrt{-(x+4)} - 3$



④ Find the domain and range for each

⑥  $f(x) = -3(x-3)^2 + 6$



④ Domain Range

a)  $[-7, -3]$   $[3, 6]$

b)  $(-\infty, \infty)$   $(-\infty, 6]$

c)  $(-\infty, \infty)$   $[-2, \infty)$

d)  $(-\infty, -2]$   $(-\infty, -3]$

⑤ Describe the transformations indicated by each function and sketch a graph without a calculator.

⑥  $f(x) = -2(x+1)^2 - 3$

Annotations: reflect x-axis, vert stretch by 2, left 1, down 3

⑦  $f(x) = \frac{1}{2}\sqrt{3-x} + 4$

Annotations: vert. compress. by 2, reflect y-axis, left 3, up 4

⑧  $f(x) = \sqrt{1 - \left(\frac{x+2}{4}\right)^2} + 1$

Annotations: left 2, horiz. stretch by 4, up 1

⑨  $-2f(x-3) + 2$ , No graph needed

Annotations: reflect x-axis, vert stretch by 2, right 3, up 2